CME Arrival Time and Impact Working Team: Events & Results

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A) 3 April 2010 10:33 UT (hit)
B) 15 March 2013 07:12 UT (hit)
C) 15 March 2015 01:48 UT (hit; problematic, many models predict a late arrival)
D) 7 January 2014 18:24 UT (false alarm; only a weak discontinuity arrives)

The Drag Based Ensemble Model (DBEM) => Dumbovic et al., 2017 (in preparation)

The idea is to make an ensemble of the drag-based model (DBM) input parameters to produce a distribution of possible ICME arrival times and speeds. This will allow us to define the most likely ICME arrival times and speeds, quantify prediction uncertainties and determine forecast confidence.

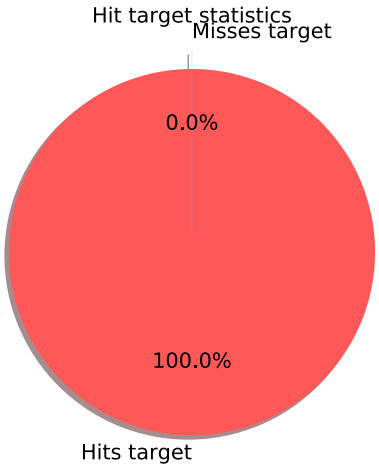
We use the DBM with assumed cone geometry for the CME, where the leading edge is initially a semicircle, spanning over the full angular width of the ICME and flattens as it evolves in time [described in Zic et al., 2015]. This is the constant solar wind speed and gamma model, where it was shown previously that both can be assumed to be constant beyond R > 15 Rs [see Vrsnak et al., 2013, Zic et al., 2015].

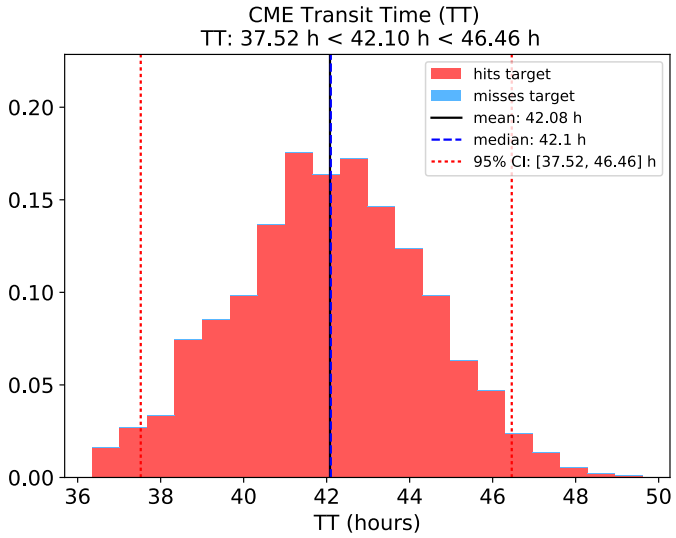
In the following the results for the 4 CCMC events are given (DBEM: >15,000 runs within ~20 sec). As first step, we give the probability of a hit or miss event for target Earth (top left). For the hits, we calculate the median, mean and confidence intervals – (CI) based on 95% percentiles – for transit time (top right) and impact speed at target (bottom left). Results are expressed as [lower CI < median < upper CI]. The input parameters are given in the box to the bottom right.

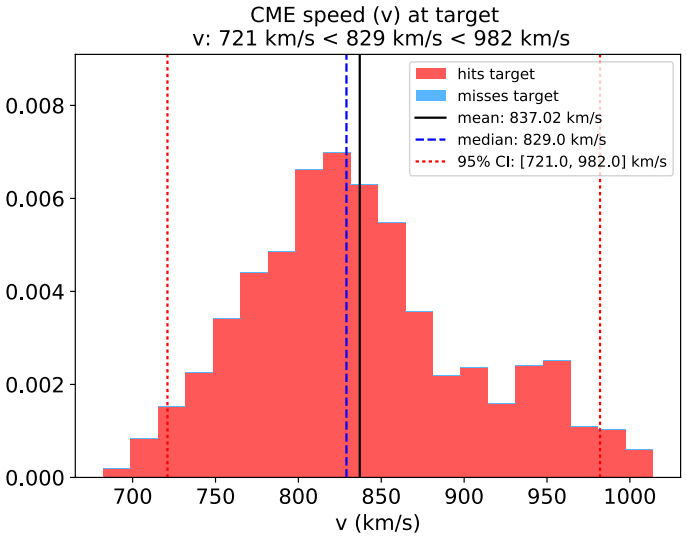
April 3, 2010 – April 5, 2010

DBEM results

arrival time: 2010-04-05 04:31:12 < 2010-04-05 09:06:00 < 2010-04-05 13:27:36
based on 15625 DBM runs, calculated in 18.84 seconds





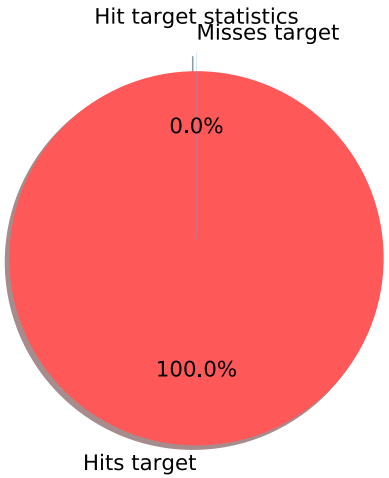


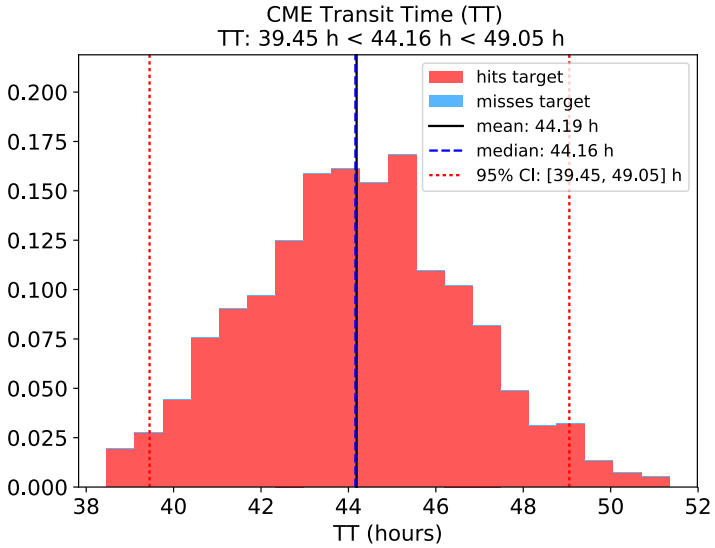
Input parameters for CME 1:
Start time: 2010-04-03 15:00 +/- 1h
CME speed: 1000 +/- 50 km/s
CME SR longitude: -10 +/- 5 deg
CME halfwidth: 30 +/- 5 deg
SW speed: 500 +/- 50 km/s
Gamma: 0.05 +/- 0.05

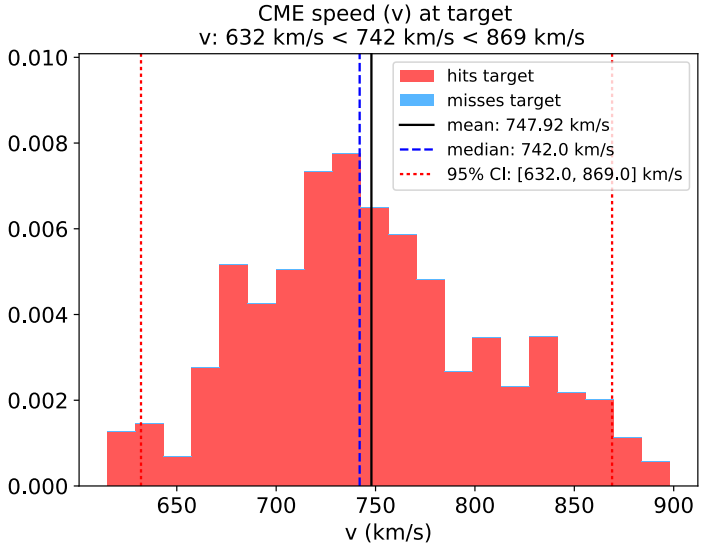
March 15, 2013 – March 17, 2013

DBEM results

arrival time: 2013-03-17 01:27:00 < 2013-03-17 06:09:36 < 2013-03-17 11:03:14.400000
based on 15625 DBM runs, calculated in 19.83 seconds





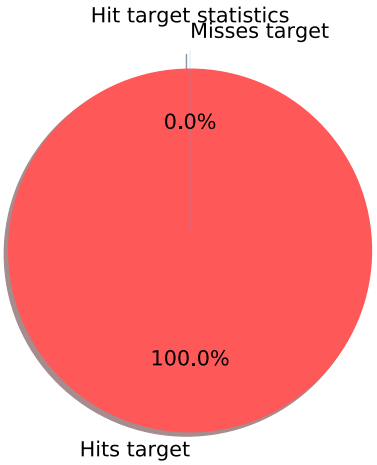


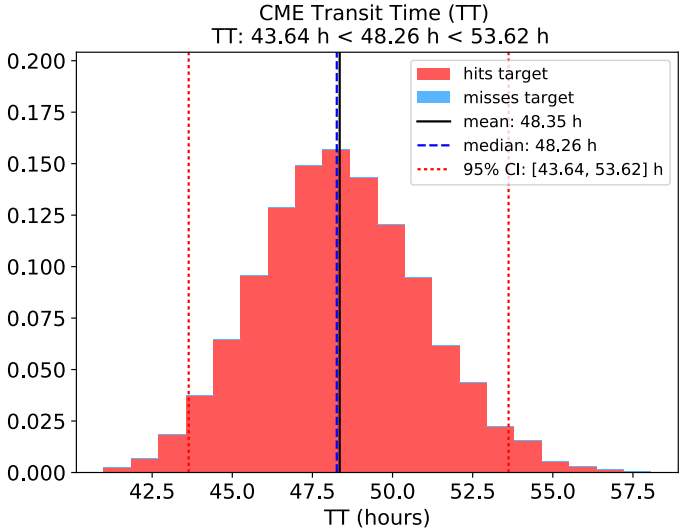
Input parameters for CME 2:
Start time: 2013-03-15 10:00 +/- 1h
CME speed: 1000 +/- 50 km/s
CME SR longidtude: 5 +/- 5 deg
CME halfwidth: 40 +/- 5 deg
SW speed: 450 +/- 50 km/s
Gamma: 0.1 +/- 0.05

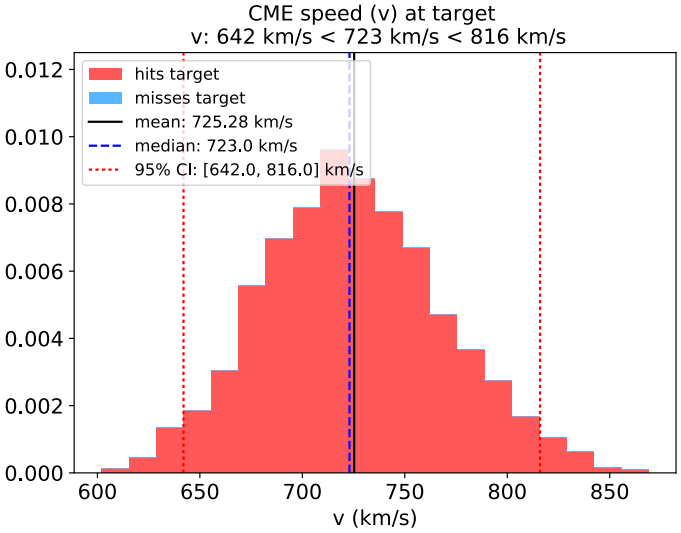
March 15, 2015 – March 17, 2015

DBEM results

arrival time: 2015-03-17 01:38:24 < 2015-03-17 06:15:36 < 2015-03-17 11:37:12
based on 15625 DBM runs, calculated in 20.28 seconds





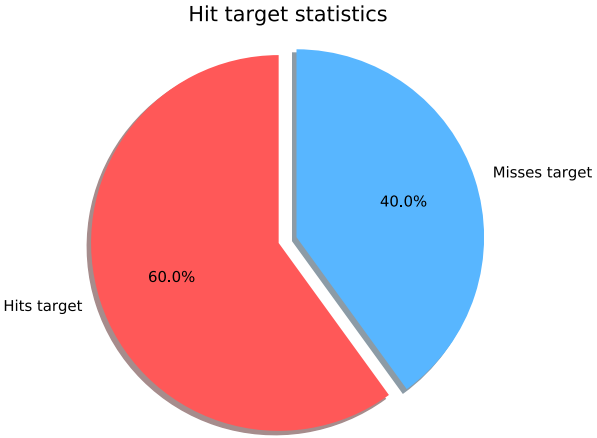


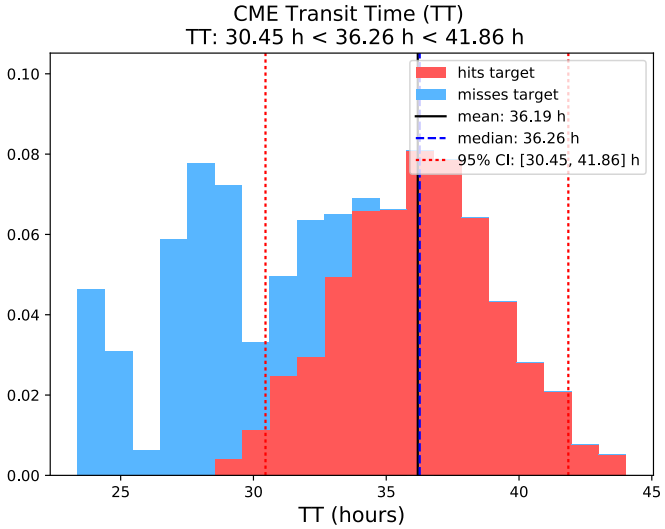
Input parameters for CME 3:
Start time: 2015-03-15 06:00 +/- 1h
CME speed: 1000 +/- 50 km/s
CME SR longidtude: 30 +/- 5 deg
CME halfwidth: 45 +/- 5 deg
SW speed: 500 +/- 50 km/s
Gamma: 0.1 +/- 0.05

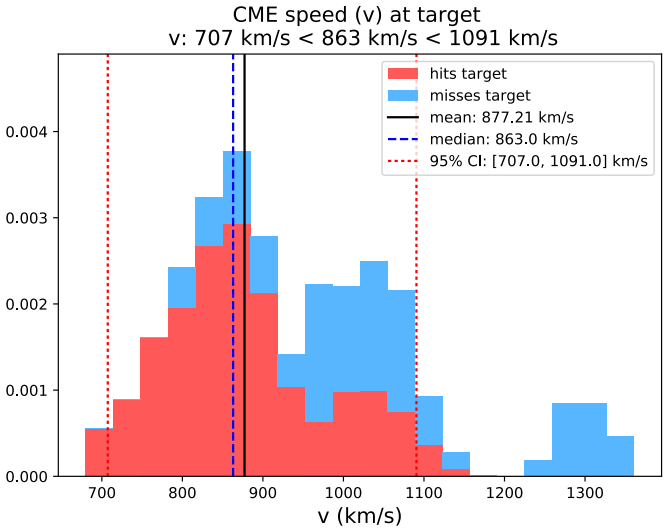
January 7, 2014 – January 9, 2014

DBEM results

arrival time: 2014-01-09 02:27:12.600000 < 2014-01-09 08:15:36 < 2014-01-09 13:51:23.400000
based on 15625 DBM runs, calculated in 20.71 seconds







Input parameters for CME 4:
Start time: 2014-01-07 20:00 +/- 1h
CME speed: 1800 +/- 50 km/s
CME SR longidtude: 40 +/- 5 deg
CME halfwidth: 40 +/- 5 deg
SW speed: 450 +/- 50 km/s
Gamma: 0.1 +/- 0.05